NEW JERSEY STATE HIGHWAY DEPARTMENT

DIVISION OF PLANNING, RESEARCH, SOILS & TESTS

BUREAU OF PLANNING & TRAFFIC

Traffic Studies and Analysis

by

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The continuous and increasing change in that important function of our daily life, highway transportation, has been observed by the average citizen of our State. He depends on highway transportation for the delivery of all types of commodities in going to and from work, in conducting his personal business and for his social and recreational needs.

He has recognized that this increasing change causes a serious problem on the present facilities available to him. This change has caused congestion, delays, accidents and fatalities. He has also realized that every effort should be made to provide adequate facilities in order to minimize traffic hazards, and that because of the magnitude and scope of the problem, he has engaged, primarily through governmental agencies at all levels, the traffic engineer, the highway engineer and the city planner to study and obtain efficiently operating major and local highway systems throughout our State.

It is our purpose here to discuss the preparation, conducting, assembling, and analyzing of traffic data in order to first measure the

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change in traffic characteristics from one period to another, and then, apply these results in the estimating of future traffic on our highways and roads.

Prior to 1940, the Highway Department had conducted three traffic surveys on the State Highways under their jurisdiction with little coverage on feeder roads. During 1940, the first Statewide Highway Traffic Survey was made covering all rural and through urban roads in New Jersey, regardless of road system. Results of the 1940 traffic survey provided a 1940 annual average daily volume for all roads in the State excepting local urban streets.

This survey was conducted as a Federal-Aid project in cooperation with the Bureau of Public Roads and the Works Projects Administration. Most of the supervisory and administrative personnel attached to the survey were regular Highway employees, and the clerical and enumerating personnel were employed by the Works Projects Administration.

This survey included counts made at 378 key and loadometer control stations, 600 four count seasonal and 4,200 single count stations. All counts were made manually at road intersections for an eight hour period, and included type and license classification and turning movement data.

At each of the 378 key stations, eighteen (18) eight hour counts were scheduled as follows: seven counts during the 6 a.m. to 2 p.m. period, seven counts during the 2 p.m. to 10 p.m. period each distributed to fall on a different day of the week, and four counts during the 10 p.m. to 6 a.m. period, one on Saturday, one on Sunday and two on weekday nights.

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This survey included counts made at 376 key and loadometer control stations, 600 four count seasonal and 1,200 single count stations. All counts were made manually at road intersections for an eight hour period, and included type and license classification and turning movement data.

At each of the 376 key stations, eighteen (18) eight hour counts were scheduled as follows: seven counts during the 6 a.m. to 2 p.m. period, seven counts during the 2 p.m. to 10 p.m. period each distributed to fall on a different day of the week, and four counts during the 10 p.m. to 6 a.m. period, one on Saturday, one on Sunday and two on weekday nights.

The field survey was conducted for a complete year and the year divided into fourteen time cycles. The State was divided into twenty-one operational areas called circuits and in each circuit eighteen key stations were operated.

With the start of the survey, or Cycle #1, the first key station in all circuits was operated on a 6 a.m. to 2 p.m. period and on each successive workday the next station in order operated until the eighteen stations were given one eight hour count. This concluded Cycle #1 and with the starting of Cycle #2, all counts were then made on a 2 p.m. to 10 p.m. period. The night period counts were interspersed within the 2 p.m. to 10 p.m. cycles.

The key station operations formed the basic source of data for the control, pattern studies and factor development for expansion of short period coverage counts. In the selection of key station locations, utmost consideration was given to cover all significant characteristics of traffic flow, so that the results produced sufficient data to develop the various traffic patterns and from these patterns, to compute expansion factors. These characteristics considered such items as:

Local or through traffic roads,

Rural or urban areas,

Area classification, examples are Northwest, New Jersey farming and dairying, North Jersey Recreational Lake Resorts, North Jersey Metropolitan Area, Central Jersey Pine Belt, etc.,

Directional Flow, east-west or north-south,

The field survey was conducted for a complete year and the year divided into fourteen time cycles. The State was divided into twenty-one operational areas called circuits and in each circuit eight-teen key stations were operated.

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In the summer of 1940, we were able to procure ten automatic traffic recorders and these machines were used for additional continuous control counts.

The first operation in processing of the field work was the summarization of the counts to an eight hour basis. Key station counts were then transcribed to an annual summary form on which totals and twenty-four hour annual average for each leg were computed.

Factors were next computed relating the seven morning and seven afternoon period counts to the annual average volume. Each leg of every key station was then classified for traffic characteristics.

The factors of station legs with similar traffic characteristics were combined to produce a composite traffic pattern. About sixty such composite patterns resulted from this survey.

Inasmuch as this type survey essentially used a sampling technique in the determination of factors for expansion of short period counts, the development and use of composite values would most probably yield the best average results. Existing abnormal conditions at the

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time the counts were made, whether known or unknown, would tend to be equalized in the grouping of factors. Abnormal conditions would include heavy snowstorm, road open to local traffic only, detour in immediate area, special events, holiday eves or post holidays, etc.

The processing of the remainder of the field counts, namely the coverage counts, were resolved into two primary functions, determination of the traffic pattern and the actual routine expansion to twenty-four hour annual average volume.

The computed A.A.D.T. volumes were then noted on positive vandykes of the Planning Survey Base Maps from which ozalid print copies could readily be reproduced.

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With the ending of the war, we found our highways in sad condition due to neglect in providing adequate maintenance and normal reconstruction, because of the shortage of labor, equipment and materials. The abandonment of travel restrictions, the replacement of vehicles of greater power and speed and the increase in the number of registrations made us immediately realize that more adequate traffic facilities must be provided.

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Where and on what basis should we start? The necessity of obtaining post war traffic data in order to determine priority of construction and the proper design of facilities, was very apparent.

Therefore, the Planning and Traffic Division of the Highway Department resumed making traffic studies first on a limited basis and then gradually increasing the coverage each year to its present annual program.

During the post war years, our traffic enumeration changed from a manual to a mechanical basis. Improvements made in the design and operating features of automatic traffic recorders, the difficulty in obtaining qualified personnel, and the increase in salaries and costs due to inflation, make the consideration and use of machine counting an essential part of any efficient statewide traffic program. At the present time, the State Highway has in use eighty senior or volume recording automatic traffic machines and eighty junior or non-recording type units.

The present program is being operated as a control and coverage program. For operational purposes, the State has been divided into eight areas, the area lines coinciding in general with certain county lines.

For the control counts, each area has four permanent, six major and twelve minor stations in operation. Major stations are operated continuously for one week out of four weeks, minor stations one week out of eight weeks. In some areas, the number of major and minor stations may vary but the aggregate counting time is equally scheduled.

The control schedule can be carried by the use of seven senior automatic counters in each area although two reserve counters are assigned to be used as replacements for repairs and make-ups.

Classification counts are made periodically and in accordance with a schedule at all machine locations. Three types of classification counts are made: (1) 24 hours once each season, (2) 8 hours 10 a.m. to 6 p.m. once each season and (3) 8 hours once each year. The type of classification count made depends on the type of traffic at the particular station. Traffic is classified by state of registration and vehicle type by general axle arrangement.

The coverage part of the traffic program is made with the use of junior cumulative non-printing type automatic traffic machines. The plan includes the determination of a twenty-four hour annual average volume for any road and street in the State.

Coverage counts are made on a sampling basis consistent with the road system. A coverage count is made on every section of State highway in the rural areas, and on every alternate section in the urban areas. On county roads, a count is made on every three sections and on local rural and urban streets one out of fourteen are counted. These coverage counts are of approximately twenty-four hour duration on any weekday.

The Supervisor of Traffic Enumeration is responsible for all field operations, including the making of control, coverage and classification counts in the eight areas covering the State. A District Supervisor of Traffic Enumeration is in charge of each of the 8 areas. He installs and operates the senior automatic traffic machines in his area, and supervises the traffic enumerators in making manual counts and installing and operating junior automatic traffic machines.

All field records are transmitted to the central office in Trenton for processing and analysis. The office personnel requirement for processing this work includes a supervisor, two assistant supervisors, eight senior clerks and ten clerks.

The automatic traffic machine tapes are transcribed to work forms in order to compute daily and weekly totals. The totals, in turn, are transferred to annual summary sheets, preparatory to pattern analysis and factor computation.

In the original selection of the stations, consideration is given to the characteristic of traffic at each location. The percentage, that the monthly average day is of the Annual Average Daily Traffic (AADT), is plotted on a graph to determine the variation curve or pattern for each station. Similar patterns are then combined to form the composite for the particular characteristic such as through rural highways, local rural roads, urban arterial roads, industrial, through resort area roads, etc.

From the patterns, expansion factors are computed for particular months for a 24 hour normal weekday or 72 hour weekend periods, to expand the coverage counts made with the junior machines.

Twenty-four hour annual average traffic volumes for the State Highway System will be plotted on a traffic flow map, to be revised about every two years.

Special traffic information including thirtieth peak hour and classification is available at many locations throughout the State. This information is available upon request of the Bureau of Planning and Traffic.

For the purpose of estimating traffic volumes along a proposed highway in a rural area, the traffic volume counts made along the existing and adjacent roads can be readily utilized. However, in urban and suburban development areas, where networks of local streets occur, the volumes of flow may be so distributed that a route alignment based on volume information alone, may not be readily discernible.

It is, therefore, necessary to obtain additional information as to the beginning and ending of the trips made by vehicles in order to determine the assignment of the trip to a proposed facility. This is the basic concept of an origin and destination survey.

Major origin and destination studies were made by the Bureau of Planning and Traffic in the Newark Metropolitan Area, Philadelphia-Camden Area and the Morristown Area.

In the Newark, Camden, and Morristown Studies procedure includes an external and internal survey. For the external survey, interview stations are established on all the major routes at the boundary of the survey area. This boundary, in general, coincides with the beginning of the rural area surrounding the urban survey area, and is known as the cordon line.

At each interview station, a representative sample of the traffic passing the station is interviewed. Minimum number of samples acceptable for a representative sample is 10% of each hourly total.

Each interviewing operation is scheduled for an eight hour period and each station generally is given a morning and afternoon operation. Where a significant percentage of traffic is found between

the hours of 10 p.m. to 6 a.m. (on important truck routes), twenty-four hour operation is made.

Trip data on various items are obtained in the interviews on trips between the survey area and the external area and trips passing through the survey area. Traffic is counted by automatic traffic recorder for any twenty-four hour period including the station operation hours and is classified during the entire eight hours of actual operation.

Hourly and twenty-four hour factors are applied to the samples according to hour, direction and type of vehicle, so that the summation of the samples as raised by the factors equals the traffic volume at the station.

In order to obtain data on the trips within the survey area of Newark and Camden, a sampling method based on geographical distribution was used, in which every thirtieth dwelling unit in the case of Newark and every tenth dwelling unit in the Camden Study was selected and listed.

By the home interview method, trip data for all members residing in a selected dwelling unit are obtained for the day previous to the day of interview. Similar trip data are obtained for trucks and taxis for a selected sample on those vehicles registered within the area.

Completed interviews are coded and punched for mechanical tabulation of origins and destinations of trips for the entire survey area. Flow distribution lines through external stations and desire

lines between zones are graphically drawn to show volumes of trips for the average weekday of the survey.

Summarization of desire lines produce major desire lines which may be individually analyzed for route studies within the survey area. In the study of a particular route alignment through an urban area where a study has been made, assignment and summation of desire lines of trips that would use a proposed facility is made in the analysis.

In a survey covering a smaller area, and having a population range from 15,000 to 50,000, the home interview method for obtaining internal trip data may be replaced by a parking survey in the Central Business District of the survey area. An external survey station interview is also made.

In conducting a parking survey, the first step is to make a physical inventory of all on and off-street parking facilities within a selected internal cordon line around the Business District. Machine and classification counts are made on all streets at the internal cordon line locations.

A group of adjacent parking spaces along a curb, a part or whole parking lot or parking garage, is assigned to an interviewer whose duty it is to obtain a complete interview from every vehicle parked in the assigned location. On each interview, the type of vehicle, time entering, leaving, and time parked, purpose of trip, origin and destination, blocks walked, and route of entry, are noted. Each location is operated for an eight hour period during the survey.

Analysis of the internal trip information is made similar to that obtained in the home interview.

A modified form of origin and destination survey had been used by our Bureau in order to obtain accurate flow volumes through complex intersections, where it was physically impossible to manually enumerate turning movements.

On each leg of the intersection, a pre-punched tabulating machine card was handed to each vehicle entering the intersection and picked up as the vehicle left the intersection. The card was pre-punched to show the hour, type of vehicle and leg of entry.

The collected cards were kept in boxes identifying the leg of exit which was later gang punched into the respective cards. During the period of field operation, automatic traffic recording machines produced the hourly volumes for each leg. These volumes were compared to the number of cards issued.

Tabulation of the cards was completed on the day following the field operation and a flow chart drawn from the tabulation showing all flows was readily produced. This type of survey was used at the Somerville Circle and the intersection of Routes 42 - 45 in Camden.

A third type of traffic study conducted by the Bureau of Planning and Traffic is the annual loadometer study. For a period of approximately three weeks in July of each year, two survey parties are assigned to the weighing and interviewing of commercial vehicles on the major truck routes of the State.

Trucks of all types are weighed on partable loadometer scales. Operations are for an eight hour duration covering the three periods of the day. Trucks to be weighed are selected to give a representative sample by type, and during the operation a classified traffic count is made at the site of the operation.

Information obtained from each truck weighed includes the make of truck, year, model, use classification, type, loaded or empty, commodity carried, origin and destination, axle loads and tire sizes.

The data for each truck is entered on a serial numbered form in the field and this form is set up so that it is almost self-coding in most of the items. Coding of the data is done as an office function and punched into tabulating cards.

Tabulations, showing comparative data for the current year with the previous year, are made on axle loads and gross weights. These data are transmitted to the Bureau of Public Roads where summaries are made from similar data submitted from other States.

Data on loading practices of trucks and truck combinations thereby becomes available on a nationwide basis and is used by highway engineers in their pavement design, by State Law Enforcing Agencies to set up limits of legal weights for legislation in the various States, by the truck manufacturers in improving their truck models, and by the trucking interests for efficient and safe operation over the highways.

I have outlined, in general, three phases of traffic survey work and analysis, volume and classification, origin and destination and loadometer studies.

These studies have presented some methods in which we have been able to determine comparative values and factors to measure traffic conditions and characteristics on our roads.

Most of these studies require considerable time, detailed work and supervision, and their cost will be directly related to the amount of data to be obtained and the area to be included in the survey.

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